

APPENDIX 3. FUNCTIONS AND SUBJECTIVE TESTS

1. DISCUSSION. Accurate replication of airplane systems functions will be checked at each flight crewmember position by an FAA Simulator Evaluation Specialist. This includes procedures using the operator's approved manuals and checklists. Handling qualities, performance, and simulator systems operation will be subjectively assessed by an FAA Simulator Evaluation Specialist qualified in the respective airplane.

At the request of a POI, the Simulator Evaluation Specialist may assess the simulator for a special aspect of an operator's training program during the functions and subjective portion of a recurrent evaluation. Such an assessment may include a portion of a LOFT scenario or special emphasis items in the operator's training program. Unless directly related to a requirement for the current qualification level, the results of such an evaluation would not affect the simulator's current status.

Operational principal navigation systems including inertial navigation systems, OMEGA, or other long-range systems, and the associated electronic display systems will be evaluated if installed. The Simulator Evaluation Specialist will include in his report to the POI the effect of the system operation and system limitations.

2. TEST REQUIREMENTS. The ground and flight tests and other checks required for qualification are listed in the Table of Functions and Subjective Tests. The table includes maneuvers and procedures to assure that the simulator functions and performs appropriately for use in pilot training and checking in the maneuvers and procedures delineated in FAR Part 61 and FAR Part 121, Appendices E and F. It also contains tests to assure compliance with FAR Part 121, Appendix H, and other regulatory provisions. Maneuvers and procedures are included to address some features of advanced technology airplanes and innovative training programs. For example, "high angle of attack maneuvering" is included to provide an alternative to "approach to stalls." Such an alternative is necessary for airplanes employing flight envelope limiting technology. The portion of the table addressing pilot functions and maneuvers is divided by flight phases. Visual systems tests are listed separately as are special effects.

All systems functions will be assessed for normal and, where appropriate, alternate operations. Normal, abnormal, and emergency procedures associated with a flight phase will be assessed during the evaluation of maneuvers or events within that flight phase. Systems are listed separately under "Any Flight Phase" to assure appropriate attention to systems checks.

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TABLE OF FUNCTIONS AND SUBJECTIVE TESTS	SIMULATOR LEVEL			
	A	B	C	D
1. <u>FUNCTIONS AND MANEUVERS</u>				
a. <u>PREPARATION FOR FLIGHT</u>				
(1) Preflight. Accomplish a functions check of all switches, indicators, systems, and equipment at all crewmembers' and instructors' stations and determine that the cockpit design and functions are identical to that of the airplane simulated.	X	X	X	X
b. <u>SURFACE OPERATIONS (PRE-TAKEOFF)</u>				
(1) Engine start.	X	X	X	X
(i) Normal start.				
(ii) Alternate start procedures.				
(iii) Abnormal starts and shutdowns (hot start, hung start, etc.).				
(2) Pushback/powerback.		X	X	X
(3) Taxi.	X	X	X	X
(i) Thrust response.				
(ii) Power lever friction.				
(iii) Ground handling.				
(iv) Nosewheel scuffing.				
(v) Brake operation (normal and alternate/emergency).				
(vi) Brake fade (if applicable).				
(vii) Other.				
c. <u>TAKEOFF</u>				
(1) Normal.	X	X	X	X

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS (Cont'd)

	SIMULATOR LEVEL			
	A	B	C	D
(i) Engine parameter relationships.				
(ii) Acceleration characteristics.				
(iii) Nosewheel and rudder steering.				
(iv) Crosswind (maximum demonstrated).				
(v) Special performance.				
(vi) Instrument takeoff.				
(vii) Landing gear, wing flap, leading edge device operation.				
(viii) Other.				
(2) Abnormal/Emergency.	X	X	X	X
(i) Rejected.				
(ii) Rejected special performance.				
(iii) With failure of most critical engine at most critical point along takeoff path (continued takeoff).				
(iv) With windshear.				
(v) Flight control system failure modes.				
(vi) Other.				
d. <u>INFLIGHT OPERATION</u>				
(1) Climb.	X	X	X	X
(i) Normal.				
(ii) One engine inoperative.				
(iii) Other.				

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<u>TABLE OF FUNCTIONS AND SUBJECTIVE TESTS (Cont'd)</u>	SIMULATOR LEVEL			
	A	B	C	D
(2) Cruise.	X	X	X	X
(i) Performance characteristics (speed vs. power).				
(ii) Turns with/without spoilers (speed brake) deployed.				
(iii) High altitude handling.				
(iv) High speed handling.				
(v) Mach tuck and trim, overspeed warning.				
(vi) Normal and steep turns.				
(vii) Performance turns.				
(viii) Approach to stalls (stall warning, buffet, and g-break) cruise, takeoff, approach, and landing configuration.				
(ix) High angle of attack maneuvers (cruise, takeoff, approach, and landing).				
(x) Inflight engine shutdown and restart.				
(xi) Maneuvering with one engine inoperative.				
(xii) Specific flight characteristics.				
(xiii) Manual flight control reversion.				
(xiv) Flight control system failure modes.				
(xv) Other.				
(3) Descent.	X	X	X	X
(i) Normal.				

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS (Cont'd)

	SIMULATOR LEVEL			
	A	B	C	D
(ii) Maximum rate.				
(iii) Manual flight control reversion.				
(iv) Flight control system failure modes.				
(v) Other.				
e. <u>APPROACHES</u>				
(1) Nonprecision.	X	X	X	X
(i) Approach procedure(s), one or more of the following.				
-- NDB				
-- VOR, RNAV, TACAN				
-- DME ARC				
-- LOC/BC				
-- AZI, LDA, LOC, SDF				
-- ASR				
(ii) Missed approach.				
(iii) All engines operating.				
(iv) One or more engines inoperative.				
(2) Precision.	X	X	X	X
(i) PAR.				
(ii) ILS.				
(A) Normal.				
(B) Engine(s) inoperative.				
(C) Category I published approach.				
<u>1</u> Manually controlled with and without flight director to 100 ft. (30 m.) below CAT I minima.				

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<u>TABLE OF FUNCTIONS AND SUBJECTIVE TESTS</u> (Cont'd)		SIMULATOR LEVEL			
		A	B	C	D
demonstrated).	<u>2</u> With crosswind (maximum				
	<u>3</u> With windshear.				
	(D) Category II published approach.				
throttle, autoland.	<u>1</u> Autocoupled, auto-				
missed approach.	<u>2</u> All engines operating				
approach.	(E) Category III published				
	<u>1</u> With generator failure.				
	<u>2</u> With 10 knot tailwind.				
	<u>3</u> With 10 knot crosswind.				
	<u>4</u> One engine inoperative.				
	(iii) Missed approach.				
	(A) All engines operating.				
	(B) One or more engines inoperative.				
(3) Visual.		X	X	X	X
	(i) Abnormal wing flaps/slats.				
	(ii) Without glide slope guidance.				
f. <u>VISUAL SEGMENT AND LANDING</u>					
(1) Normal.					
	(i) Crosswind (maximum demonstrated).		X	X	X
	(ii) From VFR traffic pattern.		---(Reserved)---		

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS (Cont'd)

	SIMULATOR LEVEL			
	A	B	C	D
(iii) From nonprecision approach.		X	X	X
(iv) From precision approach.		X	X	X
(v) From circling approach.	X	X	X	X
<u>NOTE:</u> Simulators with visual systems which permit completing a circling approach without violating FAR Section 91.175(e) may be approved for <u>that particular</u> circling approach procedure.				
(2) Abnormal/emergency.	X	X	X	X
(i) Engine(s) inoperative.				
(ii) Rejected.				
(iii) With windshear.				
(iv) With standby (minimum electrical/hydraulic) power.				
(v) With longitudinal trim malfunction.				
(vi) With lateral-directional trim malfunction.				
(vii) With loss of flight control power (manual reversion).				
(viii) With worst case failure of flight control system (most significant degradation of fly-by-wire system which is not extremely improbable).				
(ix) Other flight control system failure modes as dictated by training program.				
(x) Other.				
g. <u>SURFACE OPERATIONS (POST LANDING)</u>				
(1) Landing roll and taxi.		X	X	X
(i) Spoiler operation.				

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<u>TABLE OF FUNCTIONS AND SUBJECTIVE TESTS (Cont'd)</u>	<u>SIMULATOR LEVEL</u>			
	A	B	C	D
(ii) Reverse thrust operation.				
(iii) Directional control and ground handling, both with and without reverse thrust.				
(iv) Reduction of rudder effectiveness with increased reverse thrust (rear pod-mounted engines).				
(v) Brake and anti-skid operation with dry, wet, and icy conditions.				
(vi) Brake operation.				
(vii) Other.				
h. <u>ANY FLIGHT PHASE</u>				
(1) Airplane and powerplant systems operation.	X	X	X	X
(i) Air conditioning.				
(ii) Antiicing/deicing.				
(iii) Auxiliary powerplant.				
(iv) Communications.				
(v) Electrical.				
(vi) Fire detection and suppression.				
(vii) Flaps/slats/speed brakes				
(viii) Flight controls.				
(ix) Fuel and oil.				
(x) Hydraulic.				
(xi) Landing gear.				
(xii) Oxygen.				



TABLE OF FUNCTIONS AND SUBJECTIVE TESTS (Cont'd)

	SIMULATOR LEVEL			
	A	B	C	D
(xiii) Pneumatic.				
(xiv) Powerplant.				
(xv) Pressurization.				
(2) Flight management and guidance systems.	X	X	X	X
(i) Airborne radar.				
(ii) Automatic landing aids.				
(iii) Autopilot.				
(iv) Collision avoidance system.				
(v) Flight control computers.				
(vi) Flight data displays.				
(vii) Flight management computers.				
(viii) Head-up displays.				
(ix) Navigation systems.				
(x) Stall warning/avoidance.				
(xi) Stability and control augmentation.				
(xii) Windshear avoidance equipment.				
(3) Airborne procedures.	X	X	X	X
(i) Holding.				
(ii) Air hazard avoidance.			X	X
(iii) Windshear.				
(4) Engine shutdown and parking.	X	X	X	X
(i) Engine and systems operation.				
(ii) Parking brake operation.				

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TABLE OF FUNCTIONS AND SUBJECTIVE TESTS (Cont'd)

	SIMULATOR LEVEL			
	A	B	C	D
(5) Other.				
2. <u>VISUAL SYSTEM</u>				
a. Accurate portrayal of environment relating to simulator attitudes.	X	X	X	X
b. The distances at which runway features are visible should not be less than those listed below. Distances are measured from runway threshold to an airplane aligned with the runway on an extended 3 degree glide slope.	X	X	X	X
(1) Runway definition, strobe lights, approach lights, runway edge white lights and VASI lights from 5 statute miles (8 kilometers) of the runway threshold.				
(2) Runway centerline lights and taxiway definition from 3 statute miles (4.8 kilometers).				
(3) Threshold lights and touchdown zone lights from 2 statute miles (3.2 kilometers).				
(4) Runway markings within range of landing lights for night scenes; as required by 3 arc-minutes resolution on day scenes.				
c. Representative airport scene content including:	X	X	X	X
(1) Airport runways and taxiways.				
(2) Runway definition.				
(i) Runway surface and markings.				

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS (Cont'd)

	SIMULATOR LEVEL			
	A	B	C	D
(ii) Lighting for the runway in use including runway edge and centerline lighting, touchdown zone, VASI, and approach lighting of appropriate colors.				
(iii) Taxiway lights.				
d. Operational landing lights.	X	X	X	X
e. Instructor controls of:	X	X	X	X
(1) Cloudbase.				
(2) Visibility in statute miles (km) and RVR in feet (meters).				
(3) Airport selection.				
(4) Airport lighting.				
f. Visual system compatibility with aerodynamic programming.	X	X	X	X
g. Visual cues to assess sink rates and depth perception during landings.		X	X	X
(1) Surface on taxiways and ramps.				
(2) Terrain features.				
h. Dusk and night visual scene capability.			X	X
i. Minimum of three specific airport scenes.			X	X
(1) Surfaces on runways, taxiways, and ramps.				
(2) Lighting of appropriate color for all runways including runway edge, centerline, VASI, and approach lighting for the runway in use.				
(3) Airport taxiway lighting.				
(4) Ramps and terminal buildings which correspond to an operator's Line-Oriented Flight Training and Line Oriented Simulator scenarios.				

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TABLE OF FUNCTIONS AND SUBJECTIVE TESTS (Cont'd)

	SIMULATOR LEVEL			
	A	B	C	D
j. General terrain characteristics and significant landmarks.			X	X
k. At and below an altitude of 2,000 feet (610 m.) height above the airport and within a radius of 10 miles (16 kilometers) from the airport, weather representations, including the following:			X	X
(1) Variable cloud density.				
(2) Partial obscuration of ground scenes; the effect of a scattered to broken cloud deck.				
(3) Gradual break out.				
(4) Patchy fog.				
(5) The effect of fog on airport lighting.				
l. A capability to present ground and air hazards such as another airplane crossing the active runway or converging airborne traffic.			X	X
m. Operational visual scenes which portray representative physical relationships known to cause landing illusions such as short runways, landing approaches over water, uphill or downhill runways, rising terrain on the approach path, and unique topographic features.				X
n. Special weather representations of light, medium, and heavy precipitation near a thunderstorm on takeoff, approach, and landings at and below an altitude of 2,000 feet (610 m.) above the airport surface and within a radius of 10 miles (16 kilometers) from the airport.				X
o. Wet and snow-covered runways including runway lighting reflections for wet, partially obscured lights for snow, or suitable alternative effects.				X
p. Realistic color and directionality of airport lighting.				X

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS (Cont'd)

	SIMULATOR LEVEL			
	A	B	C	D
q. Weather radar presentations in airplanes where radar information is presented on the pilot's navigation instruments. Radar returns should correlate to the visual scene.				X
r. Freedom from apparent quantization (aliasing).				X
3. <u>SPECIAL EFFECTS</u>				
a. Runway rumble, oleo deflections, effects of groundspeed and uneven runway characteristics.		X	X	X
b. Buffets on the ground due to spoiler/speedbrake extension and thrust reversal.		X	X	X
c. Bumps after lift-off of nose and main gear.		X	X	X
d. Buffet during extension and retraction of landing gear.		X	X	X
e. Buffet in the air due to flap and spoiler/speedbrake extension and approach-to-stall buffet.		X	X	X
f. Touchdown cues for main and nose gear.		X	X	X
g. Nosewheel scuffing.		X	X	X
h. Thrust effect with brakes set.		X	X	X
i. Representative brake and tire failure dynamics (including antiskid) and decreased brake efficiency due to high brake temperatures based on airplane related data. These representations should be realistic enough to cause pilot identification of the problem and implementation of appropriate procedures. Simulator pitch, side loading, and directional control characteristics should be representative of the airplane.			X	X
j. Sound of precipitation and significant airplane noises perceptible to the pilot during normal operations and the sound of a crash when the simulator is landed in excess of landing gear limitations. Significant airplane noises should include noises such as engine, flap, gear, and spoiler extension and retraction and thrust reversal to a comparable level as that found in the			X	X

TABLE OF FUNCTIONS AND SUBJECTIVE TESTS (Cont'd)

	SIMULATOR LEVEL			
	A	B	C	D
airplane. The sound of a crash should be related in some logical manner to landing in an unusual attitude or in excess of the structural gear limitations of the airplane.				
k. Effects of airframe icing.			X	X

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AC 120-40B  
Appendix 4

APPENDIX 4. EXAMPLES (Cont'd)

Name, POI, \_\_\_\_\_ (Operator)

FAA FSDO \_\_\_\_\_

Address

City, State, Zip

Dear Mr. \_\_\_\_\_:

\_\_\_\_\_ (Name) Airlines requests evaluation of our \_\_\_\_\_ (Type) airplane simulator for Level \_\_\_\_\_ qualification. The \_\_\_\_\_ (Name) simulator with \_\_\_\_\_ (Name) visual system is fully defined on page \_\_\_\_\_ of the accompanying approval test guide (ATG). We have completed tests of the simulator and certify that it meets all applicable requirements of FAR Section 121.407 (or FAR Sections 135.335 or 125.297), FAR Part 121, Appendix H, and the guidance of AC 120-40B. Appropriate hardware and software configuration control procedures have been established. Our pilots have assessed the simulator and found that it conforms to the \_\_\_\_\_ (Name) Airlines \_\_\_\_\_ (Type) airplane cockpit configuration and that the simulated systems and subsystems function equivalently to those in the airplane. Our pilots have also assessed the performance and flying qualities of the simulator and find that it represents the respective airplane.

(Added comments as desired.)

Sincerely,

FIGURE 1. Application Letter

APPENDIX 4. EXAMPLES (Cont'd)

OPERATOR NAME

OPERATOR ADDRESS

FAA APPROVAL TEST GUIDE

(AIRPLANE MODEL)

(Type of Simulator)  
(Simulator Identification Including Manufacturing,  
Serial Number, Visual System Used)

(Simulator Location)

FAA Initial Evaluation  
Date: \_\_\_\_\_

(Operator Approval) Date: \_\_\_\_\_

\_\_\_\_\_  
FAA, Manager, National  
Simulator Program Date: \_\_\_\_\_

FIGURE 2. Example ATG Cover Page

APPENDIX 4. EXAMPLES (Cont'd)OPERATOR

<u>OPERATOR SIMULATOR CODE:</u>	BA707#1
<u>AIRPLANE MODEL:</u>	Stratos BA707-320
<u>AERODYNAMIC DATA REVISION:</u>	BA707-320 CPX-8D July 1988
<u>ENGINE MODEL AND REVISION:</u>	CPX-8D-RPT-1 June 1988
<u>FLIGHT CONTROLS DATA REVISION:</u>	BA707-320 May 1988
<u>FLIGHT MANAGEMENT SYSTEM:</u>	Berry XP
<u>SIMULATOR MODEL AND MANUFACTURER:</u>	MTD-707 Tinker
<u>DATE OF SIMULATOR MANUFACTURE:</u>	1988
<u>SIMULATOR COMPUTER:</u>	CIA
<u>VISUAL SYSTEM MODEL AND MANUFACTURER:</u>	ClearView P-T 5 Channel
<u>VISUAL SYSTEM COMPUTER:</u>	LMB-6
<u>MOTION SYSTEM:</u>	Tinker 6 DOF

FIGURE 3. Simulator Information Page



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Appendix 5

APPENDIX 5. WINDSHEAR QUALIFICATION [RESERVED]

